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(54) Cavity-forming support element made of extruded hollow sections in combination with closure members of other materials or alloys

(57) A cavity-forming support element 90 of extruded hollow section has double walls 51, 52 mutually reinforced by ribs 55 which form small cavities 5 between the walls. The inner wall 51 encloses a larger cavity 50. Closing-member insert parts comprising a tube 26 of a closing member 20 and a tube 31 of a closing member 30 are applied positively against the internal wall 51 and provide additional stability and resistance to the formation of vibrations in the support element.

FIG.1 FIG.2

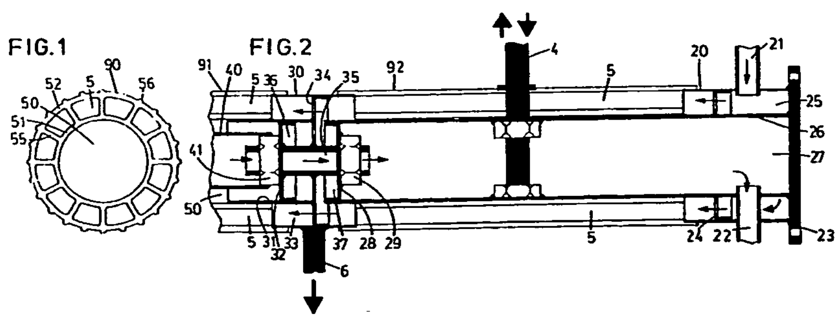

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FIG.1

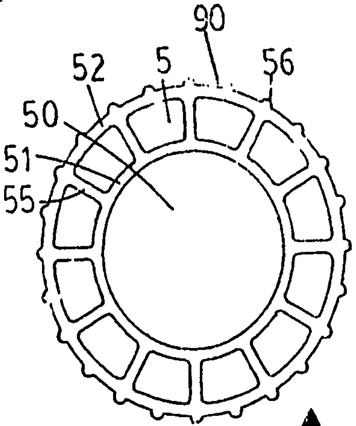

FIG.2

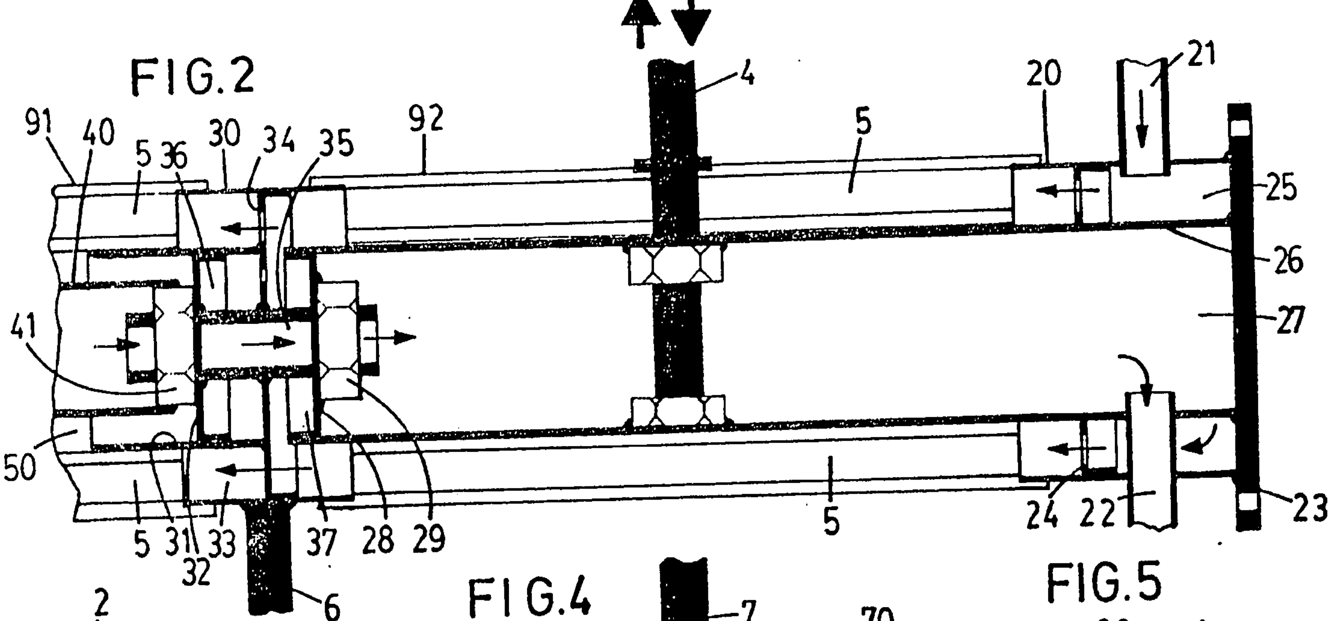

FIG.3

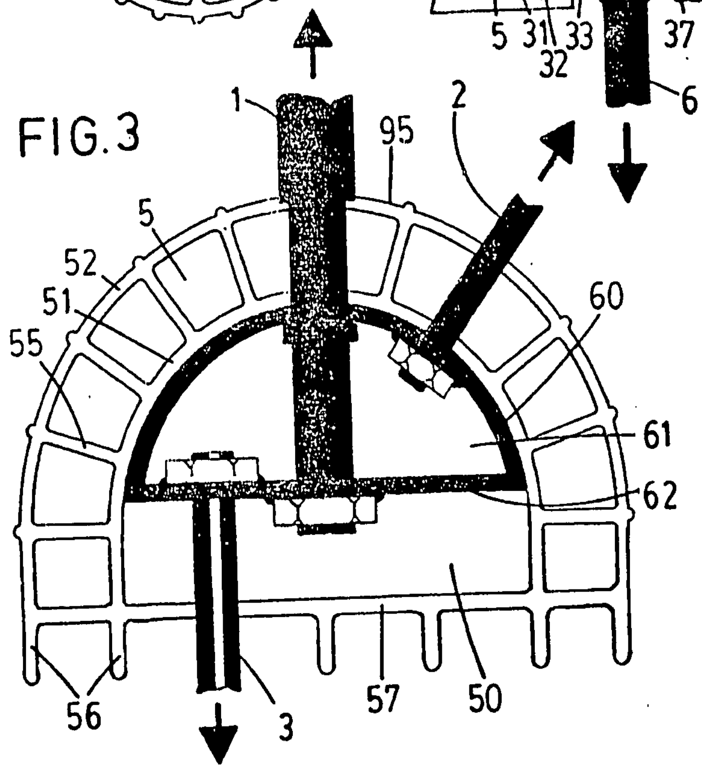

FIG.4

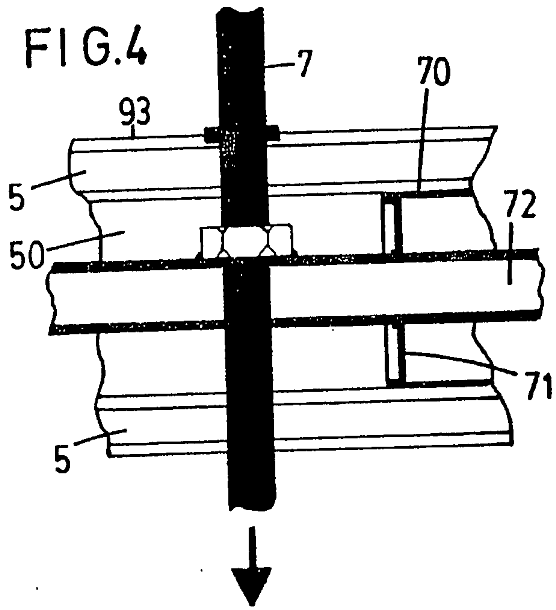

FIG.5

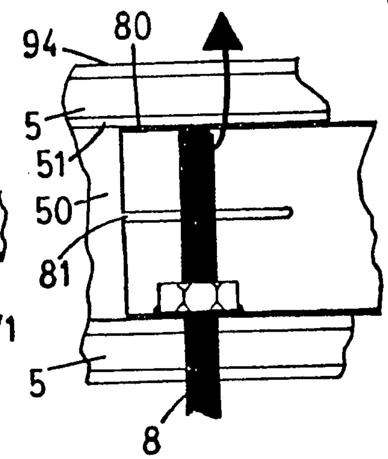

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FIG.6

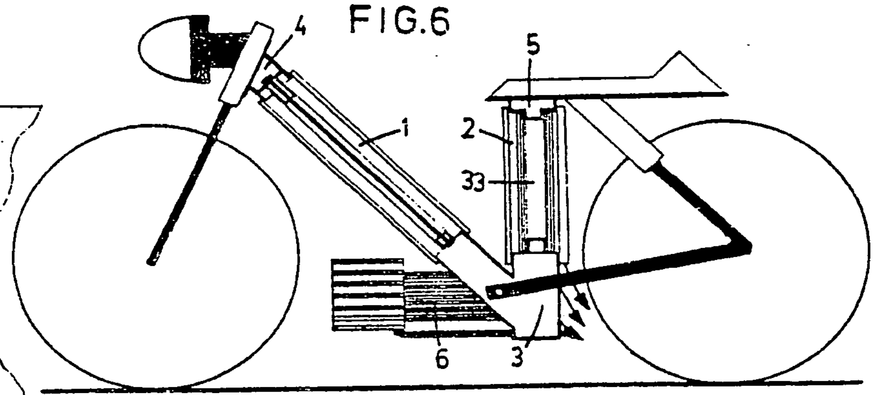


FIG.7

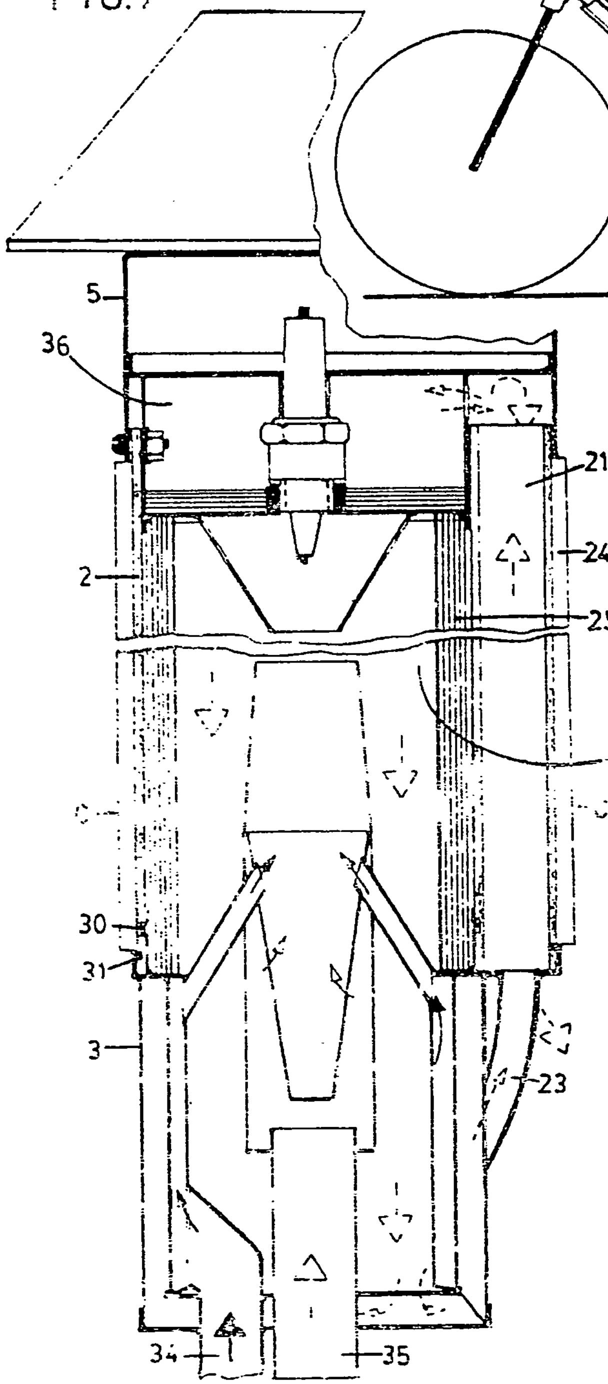


FIG.8

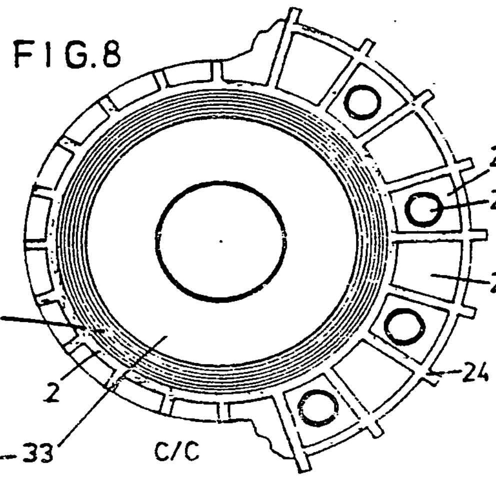


FIG.9

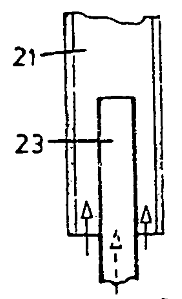
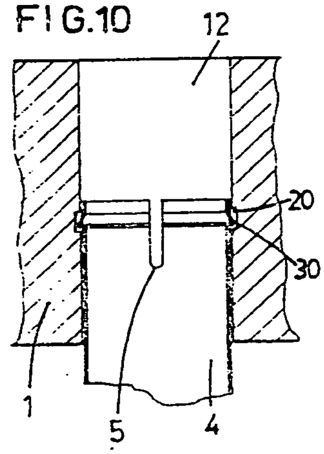


FIG.10



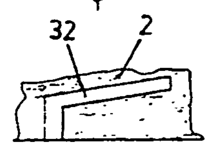


FIG.11

SPECIFICATION

Cavity-forming support element made of extruded hollow sections in combination with closure members of other materials or alloys

The invention relates to a frame and support element as a composite structure with production largely from aluminium or aluminium-fibre reinforced plastics and similar materials, the extrusion process being used as the method of production.

Such support or frame elements are torsion-resistant and are to be designed in accordance with the strength criteria of the particular field of application. Generally, they are directed toward the possibilities offered by steel in respect of production costs and material properties. The composite structural combination described below has the object of so combining in the structural unit of a frame or support element, different types of materials to form an integral element that, firstly, the frame or support element simultaneously acquires, exceeding this apparatus function, the property of a multiply differentiatable hollow body which is suitable for the development of the most varied apparatus functions, for example motor drive elements mounted in frames. Secondly, the composite structure should be suitable for so providing any point of force application in the support element that the lines of action of the force pass into the material having the greater strength or into a zone such that the properties of the mutually combined materials effectively complement one another: thus, for example, a thin-walled steel tube,by positive insertion into a double-walled aluminium hollow section member strengthened with longitudinal ribs, may thus lose any degree of freedom for the design of a vibration response. Accordingly,in the design to be determined from the field of application, it is necessary to devise an extremely rigid support and frame component which simultaneously combines in itself in a rational manner, in the form of an integral element, advantages of strength and functional progress which are derived from the purpose of the apparatus and are largely developed in hollow bodies.

This object is achieved in that the hollow section member which has no cross-walls and which is at least partly multiple-walled, is so inserted in closing and composite or combining members applied by pressure against its open ends that each of these closing and connecting members is in positive contact. These contact zones have a double structure: one at the periphery of the hollow section as a rule simultaneously representing (in the case of axial contact pressure) the contact zone of closing member/hollow section, the other with greater depth of penetration inside the walls of a hollow-section chamber, which simultaneously enclose within themselves the support (rod) axis. Finally, it is necessary to have another main feature that the formation of cross-walls is accomplished by or by means of the closing and composite members, that is either inside the closing-member cavity or with a depth of penetration into the hollow section inside a hollow-section cavity. These closing members simultaneously have the property of a composite body from several aspects. Since as a rule they consist of steel sheet or chrome-steel sheet (or nickel-plated plain sheet steel to avoid contact corrosion in respect of aluminium), initially they lie within the high strength values of these materials. It is possible for force-application points to be formed on them, without the need for multiple screw fastenings and material accumulations as for the formation of moments of force on cast aluminium parts. Furthermore, since each force is a vector and is practically always constantly distributed superficially, the lines of force from the load application to the closing member extend well into the material composite field of the rigidly designed support part, in which case the positive or interlocking contact at the periphery and the second positive contact with axial penetration depth have particular significance since thereby the form stability of the aluminium member is brought into the force field. In this way it is possible to control the load at any point of force application even in respect of the longitudinally and transversely acting components, therefore all the combined stresses from tension, compression, bending and torsion. Resistance to torsion may precisely be achieved by providing in addition to the axial pressure also radial pressure, as shown in Figure 5.

Figures 2 to 5 illustrate diagrammatically another essential property of this composite structure. They show that from any outer position of the material external shell having lower strength not only can a force-application point be made possible, which is anchored in the material having greater strength, but also by using hollow structural elements an inlet or outlet path for media which pass into the cavities formed. This latter is illustrated in Figure 2 on the basis of a closing member. Since the diagrammatic drawings 2 to 5 illustrate comprehensively a plurality of the force and inflow connections possible in this case,they merely give the appearance of a complicated design. In an individual application it is frequently sufficient to make do with a limitation to the closing and composite or combining members as respective starting zones. Similarly,Figure 3 also has the nature of a limiting case, since its starting point is a partly single-walled hollow-section extruded aluminium component. From the point of view of "all round" shape stability of an extruded aluminium section member, the section (90) shown in Figure 1 represents the almost ideal type. The double walls 51,52 are mutually reinforced by longitudinal ribs 55, with simultaneous formation of small cavities 5, and the inner cavity 50 encircles the longitudinal axis of the hollow section member. Closing-member insert parts, such as the tube 26 of the closing member 20 (Figure 2) or the tube 31 of the closing member 30 (Figure 2), applied positively against its internal wall 51 provide additional stability and resistance to the formation of vibrations, even if they are made of chrome steel. This latter effect can be intensified by surrounding edges of a wall 71 closing the insert part 70 about a pipe 72 (Figure 4) used for bracing, so that in many cases only a slight penetration depth (70) is adequate. A

pressure directed from the interior of the insert part 80 (Figure 5) against the inner wall 51 of the hollow member 94 can compensate forces applied from the main part 80 of the closing member (not shown) so that the insert part 90 remains resistant to torsion. Figure 2 shows the double fastening of a steel rod 4,against which a force application takes place, inside an insert part 26.

Figure 3 shows the fastening of externally introduced steel rods (1,2) and hollow body (3), which represent passageways for flowing media; said hollow body is situtated between the series of hollow section members 91/92 (Figure 2) in the screwed part 35 tightening the closing member and closing-member parts 26 and 40 respectively, which screwed part is rigidly secured to the walls 32 and 34 in the central closing member 30. Figures 2 and in particular include indications concerning the greatly differentiated through-flow regulation of gaseous or liquid media, for which the supports simultaneously serve as a result of their integral function provided. By way of example, if the cavity formation inside the series 20/92/30/91 (together with return 40/35/27/22) had been designed as a series of silencing components, the cavity 37 could serve as a Helmholtz resonator and the cavity 36 as an acoustic branch chamber.

When in the introduction to the description the aim of strength was designated as being the attainment of an extremely rigid body, this is to be understood as a superelevation in design relative to the limit stress to be considered within the field of application of the equipment. An absolutely rigid body does not exist in practice and even the teachings on special structures consider their junction points more precisely as joints. Accordingly, it should be merely stated that all the numerous practical means are to be employed, which enable the extra tolerances always possible in composite systems to be avoided. Figure 2 shows, for example, a simple means of this type for the fastening of the rod 4 in two nuts: since the angles of the thread starts in two nuts arranged in this way practically never correspond exactly, the entry of the rod into the second nut will practically always take place with difficulty, without it necessarily leading to destruction of the thread structures. This circumstance may be exploited as being favourable for the fastening of the rod. In the matter of this question purely of principle, reference is to be made to Claim 4 in which it is stated that in many applications it is appropriate, instead of the closing and composite members,to make use of support parts inside the hollow section, in particular fastened to their shaped insert parts, as mounting position, supporting members or connecting junctions of frame members. The reason for this, already mentioned a number of times, is that for the magnitude of load of the force field applied to the rods a combined strength is formed, in which the strength value of the shaped steel part (e.g. 26 in Figure 2) is increased by the shape-stability values of the shaped aluminium part (92). For equipment whose strength testing requires static tests as well as dynamic testing (tension impact, crushing pressure, impact bending), the structural study of the strength behaviour is recommended, particularly with strength-exceeding means, offered by this compound fastening of the support parts inside the hollow section. Since these elements may be combined as rods or hollow shafts to form force couples (see Claim 8), a further means is provided of controlling all the force magnitudes with their possible transverse components by suitable structural composition.

Since the prerequisite for this lies simultaneously in the fact that the hollow-section/closing-member combination does not allow either additional tolerances resulting from different material expansions in the event of heat input, or generally loosening or slackening conditions in the cold state at ambient temperature, very special significance is attached to the concrete process by which hollow section members and closing members are fixed one inside the other. The Claims 14 to 20 include the embodiment of a compound system which has similar qualities to a welded joint of steel to steel. According to requirements, the effect can be improvded with different complementary means : the spring or snap fastening/ rotary fastening combinations including the hardenable compound introduced into the contact zone result in excellent fastenings for force applications from all possible directions. Simultaneously, the production assembly is considerably more economical.

Figures 1 to 5 relate above all to the strength relationships developed between the basic elements of hollow section/closing member/rod-like support part. Figures 6 to 11 illustrate with the diagram of Figure 6 primarily a concrete embodiment of a motor-driven two-wheeled vehicle chassis. The hollow-section/support part 101 is secured in the closing members 103 and 104 by means of an axially extending rod connector; the hollow-section/support part 2 is secured by means of the connecting means described in Claims 14 to 20, since a hot-gas passage or even a secondary-combustion unit, according to Figures 7 to 11, is incorporated therein and the material expansions occurring thereby have to be taken into consideration. The high-temperature resistant fastening of the support part, provided according to Claim 13, by means of a hollow section member of insulating and porous material introduced into the closing-member mounting is evident from Figures 7 and 8. In special cases it is possible for a scale-resistant casing of perforated sheet metal to be additionally installed in the inner chamber 33 so as to protect the insulating member from the occurrence of elevated shock waves. The heat-exchange and silencing system of the secondary-combustion unit, for example as described in U.S. Patent Specification no. 3989469 and Austrian Patent Specification no. 336353, may also be accomplished in an extremely simple production method by means of integration into the aluminium hollow section member. Figure 9 illustrates the use of a thin jet of hot gas 123 for the formation of a cooling-air injector inside an aluminium gas-conduction duct 121, both for cooling the emerging exhaust gas and for protecting the hollow section member from excessive impingement with hot gases.

CLAIMS

1. Cavity-forming support element made from one or more extruded hollow section members, particularly of aluminium or aluminium-fibre reinforced plastics or similar materials which can be extruded economically, which are enclosed or interconnected by closing and composite members made of different materials or alloys, characterised in that the hollow section member, which has no cross-walls, is at least partly multiple-walled in cross-section in relation to its peripheral walls, has a cavity zone generally comprising the cross-sectional centre and larger than the other cavity subdivisions, has smaller cavity subdivisions which are formed by double-walled zones or by cell-type subdivisions of the cavity zones located between the multiple walls, and at least two closing and composite members, each of which forms a positive contact with the hollow section member, one part being applied with positive contact against the periphery or having approximately normal inward or outward groove or surrounding edge depth, and the other part having positive contact with depth of penetration into a cavity subdivision of the hollow section member, which as a rule comprises the centre of the cross-section either directly with or without connection to the corresponding shaped part of the other closing member which directly has such a positive contact, in that the closing members effect cross-wall formation in relation to the cavity subdivisions of the hollow section member, that in themselves or within the penetration depth of one of its shaped parts, with respect to a single hollow section member or a series of hollow section members interrupted and combined by closing and composite members.

2. Cavity-forming support element according to claim 1, characterised in that it is completed by a steel rod which partly passes through the hollow section member and is fastened to an inner positive-contact part of special design, or to the positive-contact part of a closing and composite member.

3. Cavity-forming support element according to claim 2, wherein the support part inside the hollow section member is arranged to pass completely through the hollow section member.

4. Cavity-forming support element according to claim 2 or claim 3, characterised in that the rod-like support parts, which pass through the hollow section members are used also or exclusively as mounting position, supporting members or connection junctions of apparatus frames, or for the formation of plane or three-dimensional framework elements and thereby substantially relieve the closing members of load.

5. Cavity-forming support element according to one of the preceding claims, characterised in that the support part inside the hollow section member is of tubular design and contitutes a passageway which is inserted for the purpose of throughflow in the series of cavities in the support element.

6. Cavity-forming support element according to any of claims 1 to 5, characterised in that the fastening surface or cavity zone of the support parts inside the hollow section member is a component of the penetrating shaped part of a closing member which is applied against the inner wall of the hollow section member at maximum expansion with positive contact or force fit.

7. Cavity-forming support element according to any of claims 1 to 6, characterised in that within a series of hollow section members, which are identical in respect of their inner cavities penetrated by inserted shaped parts of the closing members, adjacent hollow section members, of which at least one is traversed by a support member inside the hollow section member, have penetrating closing-member/shaped parts of identical or similar shape-,which are rigidly fastened to one another.

8. Cavity-forming support element according to any of claims 1 to 7, characterised in that rod-like support parts are provided inside plane or three-dimensional framework structures also on the closing members, which support parts are connected to support parts inside hollow section members to form spatial force couples.

9. Cavity-forming support and frame element according to any of claims 1 to 8, characterised in that the frame or support series of the overall design having all possible series of cavities is used for the throughflow of gaseous or liquid media,according to the type of apparatus, and in this case the passageways of the rod-like support parts having tubular shape and the hollow-section member inner cavities are used efficiently from a production technology aspect according to their different high-temperature strength values.

10. Cavity-forming frame group according to any of the claims 1 to 9 as an encapsulated or support (chassis) element of internal-combustion engines, characterised in that all the tanks or reservoirs (for fuel, oil, coolant, exhaust gases) hitherto provided as attachments are substantially integrated therein.

11. Apparatus according to claim 10, characterised in that the tubes ("cellular tube") provided for exhaust gases at the engine outlet are constituted by tubular support elements according to one of the preceding Claims, which are made of steel.

12. Apparatus according to any of claims 1 to 11, characterised in that the passage of hot media takes place according to the regulation of thermal media conduction inside hollow section members of limited heat resistance, that is either by insulating intermediate layers or as a result of the fact that the walls (termed baffle or deflection walls) facing the hot-gas flow consist of materials having relatively high heat resistance, and the longitudinal walls, insofar as they are made of materials having heat resistance which may be adversely affected (according to the application of the apparatus), are swept by cooler media on the side where their surfaces are exposed to high temperatures.

13. Cavity-forming support element according to any of claims 1 to 12, characterised in that a hollow section member, in particular an extruded hollow section according to Claim 1, is covered on its inner wall having limited heat resistance by a rigid hollow section member applied with positive contact and likewise generally open at both ends, which hollow

section member is inserted into the closing-body mounting and consists of a ceramic light-weight material of porous structure, and which in that wall-surface zone impinged by a stream of hot gases is compressed to greater extent or has a special surface hardening, for example by a self-curing ceramic dipping compound.

14. Cavity-forming support element with an aluminium extruded part which is enclosed in closing and composite members, characterised in that the composite insertion of the hollow section member into the closing member is effected in such a way that inside the inner cavity of the hollow section an insert part applied with positive contact is so provided with a bead-like protuberance and with a slot-type deflection cavity, in so far as it is designed to apply contiguously against the periphery, that the insert part fitted under pressure, as a result of the gradually increasing slip angle of the bead in the bead zone, is deflected into the slot-like cavity or in another manner, until the bead, after reaching a joint or groove-like recess of the inner wall of the hollow section engages therein.

15. Cavity-forming support element with a snap fastening according to claim 14, characterised in that the protuberance is formed in another way, for example as a conical embossing which engages in matching recesses in the inner wall of the hollow section.

16. Cavity-forming support element having an extruded aluminium hollow section inserted into closing and composite members, characterised in that composite insertion is formed by a conical or hemispherical protuberance which is introduced as far as a stop into an initially longitudinal channe-like recess zone of the wall of the hollow section, and then with rotation of the closing member in the direction in which the channel extends with increasing distance from the end of the hollow section a transverse wall of the closing member is pressed with increasing pressure against the end of the hollow section opposite thereto.

17. Cavity-forming support element with an aluminium hollow section inserted in closing and composite members, characterised in that the snap fastening according to claim 14 is applied to a wall of the hollow section respectively to its inner surface, whereas the rotary fastening according to claim 16 is applied to its outer surface, or *vice versa*.

18. Cavity-forming support element with an aluminium hollow section inserted in closing and composite members, characterised in that both types of fastener of claims 14 and 16 are applied on one side to the same hollow-section wall and insert part has in the first insert zone the peripheral bead and in a last insert zone has the punctiform protuberance introduced into a channel.

19. Cavity-forming support element according to any one of claims 14 to 18, characterised in that in the contact region of the composite zone of hollow section member/closing member there is provided a hardening adhesive (usually ceramic).

20. Apparatus according to claim 19, characterised in that in the case of a composite system with contact between an aluminium wall and sheet steel the spacing adhesive or hardening agent prevents contact corrosion and, if necessary, the positively contacting surfaces already provide such spacing zones directly from their shaping process.

21. Cavity-forming support group according to any of claims 1 to 20, characterised in that the cooling system of internal-combustion engines is integrated within its passageways serving for the flow of liquid or gaseous media.

22. Cavity-forming support group according to any of claims 1 to 21, characterised in that a casing is provided therein or externally surrounding it, which casing comprises essential parts or the entire apparatus in a compact design and which is designed with the features of claim 1.

23. Cavity-forming support group according to any of claims 1 to 22, characterised in that it is provided as frame unit for motor-driven equipment, in particular motor vehicles.

24. A cavity forming support element substantially as described with reference to and as illustrated in Figures 1 to 5 of the accompanying drawings.

25. A vehicle chassis substantially as described with reference to and as illustrated in Figures 6 to 11 of the accompaying drawings.

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